A Pilot Study on e-Learning in Small Online Discussion Groups and Experimental Design in Biology

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Abstract: This pilot study focuses on assessing the effectiveness of discussion in small online student groups. More effective learning may be promoted through properly designed discussion tasks. These can be effective learning tools to promote creativity, student-student and student-teacher interactions, as well as promoting understanding for the learner. A two-week online course was designed for Advanced level biology students aimed at establishing an online learning community to encourage discussion of experimental procedures in small groups of 5–9 students. The study was carried out during a 2-week slot in 2016 and in 2017 with 28 and 38 students respectively. Results based on average scores for the various assigned activities were positive. Most students appreciated acquiring skills when using discussion forums. Students mentioned difficulties with meeting deadlines and the technology. The course needs some tweaking to facilitate further students' participation.

Keywords: Blended learning, online course design, small discussion groups, biology teaching and learning

Blended learning is a form of learning where traditional face-to-face (F2F) methods are combined with digital materials. Figure 1 shows a spectrum of various teaching methods from traditional F2F to the completely online method.

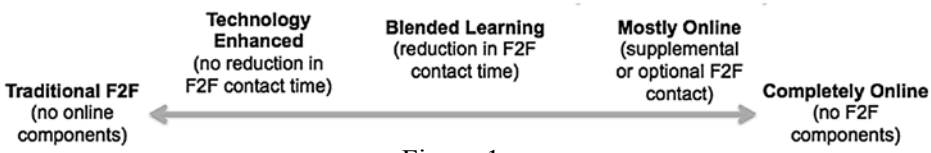

Figure 1

F2F and completely online methods have advantages and disadvantages. The F2F environment makes it easier for teacher and students to bond and interact during the discussion; there is more spontaneity which allows for a more rapid exchange of a chain of associated ideas. However, not everyone can participate especially if there are dominant personalities in the class and time is limited so one might not be able to reach the discussion depth one would like.[1] 'Pacing' of the traditional classroom to match discussion or teaching in a traditional class with the individual students' ability to learn is difficult.[2] Asynchronous text-based discussion in an online computer-mediated environment provides flexibility for students so they can contribute to the discussion at the time and place that is convenient to them; 100% of students can participate as time and place constraints are removed; it also provides chance for more reflection as learners have time to more completely consider and provide evidence for their claims as a result of deeper and more thoughtful reflections. Its weaknesses include little or no spontaneity at the cost of less generation of a rapid chain of associated ideas; procrastination and the medium is considered to be impersonal due to poor human connections.

Blended learning seeks to take advantage of the best of both traditional and completely online learning. The focus of this study was to assess the effectiveness of discussion of experimental design procedures in small student groups in an online blended learning environment.

1 C.R. Graham, 'The Handbook of Blended Learning Systems: Definitions, current trends and future directions', in *Handbook of Blended Learning: Global perspectives, local design*, ed. C.J. Bonk and C.R. Graham (San Francisco, 2006), 3–21.

2 Qiuyun Lin, 'The Role of Web-Based Activities in Mediating Student Interaction and Engagement in Four Teacher Education Classes', *Journal of Online Learning and Teaching*, 7 (2011), 99.

Discussion is an important aspect of active learning. Class discussions offer students opportunities to test their ideas and opinions against the ideas and opinions of their peers.[3]

Studies have shown that online discussion can be an effective tool to foster collaborative learning,[4] provide more productive use of class time,[5] as well as increase active learning.[6]

The topic for discussion in this study was experimental design as this is the underlying process of scientific investigation. Students may recognize the general steps involved in scientific investigation but often have only a surface understanding of the process.

Hands-on experience in the design of experiments has been widely recognized as an effective means of teaching experimentation and as a critical component of undergraduate science education.[7]

In the early stages of the biology programme at Junior College (JC), students complete the first part of a laboratory set of practical sessions in which they design and conduct their own experiment before answering questions on a worksheet relating to the analysis of the data and interpretation of their results. As they progress through their studies, there are opportunities to design experiments in subsequent practical sessions. However, students struggle to design their experimental procedures, possibly because there is little time for discussion of their procedures. The following pilot study focused on assessing the effectiveness of online discussion in terms of JC students' understanding of principles of experimental design as currently expected by the Advanced Matriculation Biology syllabus (Malta).

Aim: To design and assess an online two-week course for JC students studying Advanced Level Biology and assess the effectiveness of resulting online discussion groups.

3 'The Importance of Class discussions – Speaking in the Disciplines, University of Pittsburgh', http://www.speaking.pitt.edu/instructor/class-discussions.html accessed 30/08/2017.

4 K. Mäkitalo-Siegl, 'From multiple perspectives to shared understanding: A small group in an online learning environment'. *Scandinavian Journal of Educational Research,* (2008), 52(1), 77–95.

5 H. Alkharusi, A. Kazem, & A. Al-Musawai, 'Traditional versus computer-mediated approaches of teaching educational measurement'. *Journal of Instructional Psychology*, 37 (2010), 99–111.

6 R, McCrory, R. Putnam, & A. Jansen, 'Interaction in online courses for teacher education: Subject matter and pedagogy', *Journal of Technology and Teacher Education*, *16* (2008), 155–80.

7 D.J. Adams, 'Current trends in laboratory class teaching in university bioscience programmes', Bioscience Education, 13 (2009),1–13.

Materials: Online course designed for the purpose of this pilot study based on principles followed at ION;[8] 2 groups of 28 and 38 students in 2016 and 2017 respectively.

Method: The study was carried out in two main steps.

Step 1: Design of an online two-week course as a form of blended learning.

Step 2: Students' feedback responses were studied and analysed.

Step 1: The online two-week course was entitled Experimental Design Practice and Discussion Online Course (EDP-DOC). The two-week online course was designed for First-year Advanced Level Biology students, based on principles followed at ION. The aim of the course was to establish an online learning community among students to encourage discussion of experimental procedures in small groups of 5–9 students.

The online course consisted of a Course Home Page, Module One (Icebreaker activity), Module Two (Experimental Design Activity), & Reflection Activity.

Course Home Page was designed to include an overview of course information regarding syllabus covered during the course, expectations of students' participation, and a calendar of due dates with scoring points for the various course assignments. Course readings/resources and a note on course communications forum were also included. The course activity was designed to form part of the third assessment in the first-year advanced level programme. The maximum score for participation in the course was 80 marks.

The course consisted of two main modules:

Module One: This module was designed to help students participate in an ice-breaker activity with the aim of establishing an online learning community as well as to learn to navigate online using the online discussion forum on a Moodle (VLE) interface. The module was entitled 'Introducing Ourselves'. Students were asked to introduce themselves, post a relevant photo, and respond to at least two of their peers. This first module scored 20/80 points. This forum was open to all participants.

8 ION (Illinois Online Network – University of Illinois) – MVCR (Making the Virtual Classroom a Reality) courses.

Module Two: 'Experimental Design Activity'. In this activity students were split up into small groups of 5–8 students. The activity consisted of three main tasks. Task One: Each student booked an experimental design question from a list of questions (taken from AM or JC past papers), so each student had to work on a particular experimental design problem. Students were asked to avoid booking a question already chosen by one of their peers within the group, if possible. The reason for this was to make possible the discussion of different questions related to experimental design within the small group. Task two: After referring to course readings/resources, each student posted his first response to the question and gave feedback to at least two of their peers within the small group. Task three: A final revised answer was eventually posted by each student.

This activity was designed to encourage discussion within the 'small group' forum. The purpose of this assignment was to give each student an opportunity to design his own experimental procedure, which can be carried out in the lab and answer questions relating to the procedure. In addition each student was expected to receive and give feedback on various experimental designs and related questions within his small group. This activity scored a maximum of 50/80 marks.

My role as facilitator during the course was to give feedback to students as necessary, taking care not to take the central role but rather to be a 'guide on the side' of the various threads of discussion in the forums.

Reflection Activity: In this last activity, students were asked to give feedback on the following aspects of the course: Their biggest take-away from the course; The most useful resource or activity during the course; The least useful resource or activity; Other comments or reflections regarding their personal learning experience or online learning in general. This activity scored 10/80 points.

Step 2: The study was carried out during a 2-week slot at the end of March–April in 2016 and in 2017 with 28 and 38 student participants respectively.

The course was introduced to the class in a face-to-face session. Students were asked to get their own tablets or smartphone so they could access the course online on their VLE in the classroom.

Netiquette rules were outlined, while the importance of practising positive feedback and respect for others online were pointed out. The different parts of the online course as seen online were demonstrated in class. This was followed by a short practice session using the facilities of the discussion forum in Module One. This was necessary as most – if not all – students in the group were not familiar with the use of the discussion forum. During the first week, scheduled for Module One, some students still experienced difficulty in using the discussion forum and uploading photos. These difficulties were sorted on a one-to-one basis. The various activities were graded by me as facilitator.

Also as facilitator, I gave feedback online when required, especially during Module Two.

At the end of the course, quantitative data resulting from scores obtained by students in the various activities was collected and grouping of a number of feedback comments was also carried out.

Results

April 2016 (First week of the third (final) term of the scholastic year (28 participants)

	Module 1	Module 2	Reflection	Course Total
Average score	16	40	5	61
Maximum score	20	50	10	80
No. of final postings by due dates	28	17	0	–

Table 1 Average scores and number of final postings by due date in April 2016

All 28 participants took part in the Module 1 (icebreaker activity) and all students posted by the due date.

Twenty-seven participants posted their initial response in Module 2 but 23 students posted their revised work; 4 of the 27 participants did not compete the Module as they failed to post their revised work. Seventeen of the 27 participants posted their revised work by the due date.

Fourteen out of the 28 participants gave their feedback in the end of course Reflection Activity; none of the 14 students posted by the due date for this activity.

April 2017 (Last two weeks of the second scholastic term) (38 participants)

	Module 1	Module 2	Reflection	Course Total
Average Score	19	40	7	66
Maximum score	20	50	10	80
No. of final postings by due date	33	0	6	–

Table 2 Average scores and number of final postings by due date in April 2017

Thirty-five students took part in the Module 1 activity; 33 posted by the due date.

Thirty-five students posted their initial response in Module 2 but 4 failed to post their revised responses. None of these students posted by the due date.

Twenty-eight students gave their feedback in the end-of-course Reflection Activity and 6 of these posted by the due date. Twenty-two students posted past the due date as they encountered problems or could not cope with the work load.

***Feedback from students*:** 14/28 students posted their feedback in the Reflection Activity in 2016 and 28/38 students gave their feedback in 2017 Reflection Activity.

The Reflection Activity asked for feedback on four main points:

The following are some first-hand responses from students.

1. *Biggest take-away*

A number of students appreciated the experience in the following areas:

i. Use of VLE discussion forums to give and receive feedback from fellow students in a learning online community;
ii. Team work can be critical to improve one's work; opportunity to analyse another peer's work and give feedback for improvement; opportunity to work with others; 'I also got the chance to be exposed to how different individuals tackle questions' by using a

different approach. More confident when answering experimental design questions; more confident communicating with colleagues online;

iii. Devise, learn about more reliable and reproducible experimental design and procedures;
iv. Learnt to analyse questions/more critical thinking;
v. Fun and out of the ordinary activity;
vi. Netiquette rules;
vii. Handy skills for the future when participating in other online courses;
viii. Greater awareness of the benefits of using reliable resources online

2. *Most useful resources/activity*

The comments here again reinforced an appreciation of the advantage of the discussion forum:

i. All the participants in the group answered different questions so that we could discuss them. I found this very useful as we didn't have to work them all out but at the same time we could discuss the questions assigned and think about the answers. It was great that we all had a copy of the answers to the different questions in the end. (2016);
ii. Broaden my knowledge of experimental design;
iii. Feedback from peers and tutor;
iv. Answering and discussing exam-related questions;
v. 'We posted our answers and received feedback to rearrange our answers';
vi. Learn from our mistakes;
vii. The fact that we were free to comment or hand in our work at any time of day. Also, I liked the reviewing aspect of this course.

3. *Least useful resources*

i. A number of students commented that the Module1 (Icebreaker activity) was a waste of time

(Other students felt differently – icebreaker activity helped them learn more about classmates/class go to know each other a little bit better)

4. *Other comments*

i. Deadlines were a problem as I couldn't keep up; little time to read/use resources;
ii. Dependence on the internet/computers which are not always available or reliable;
iii. Internet resources have to be reliable as in some cases information is not correct;
iv. The reply system on the VLE can be frustratingly slow and should be more user friendly;
v. I would have preferred if this assignment was assigned to us either during the previous term (this course[2016] took place at the beginning of the third term, after the Easter holidays), or during the Easter holidays, as much more time would have been devoted, on my side, to the course. This is so since the third and final term is the most stressful of the three, and so I feel that I did not provide my utmost towards this course.
vi. Prefer pen and paper in some cases! (2017);
vii. I did enjoy the idea of a forum like this being used for other subjects as well. Having open threads for each module could help those people who are looking to answer specific questions. It could also facilitate resource sharing between the class. (2016);
viii. Not everyone takes the same time to study a particular topic and I personally prefer online learning over traditional classroom setting. This is because most lectures could be easily recorded and uploaded online, to be listened to as needed and at one's own pace. Besides, traditional lecturing isn't the most exciting way to go around learning a subject in my opinion. There are so many better alternatives online and that's why I think open threads per module would be beneficial for, it would help us gather the best sources and make them easily accessible to others. Lecture time could be re-purposed for more tutorial-like discussion-oriented activities. (2016)

Discussion: Results based on average scores over the 2016 and 2017 two-week courses were in the region of 79% with 76.25% in 2016 and 82.5% in 2017.

For Module 1 (Icebreaker activity), the average scores were 16/20 (80%) in 2016 and 19/20 (95%) in 2017. This indicates a high level of interest, participation, and effort by the participants.

In the Module 2 activity, average scores were 40/50 (80%) for the experimental design activity module. Again these scores indicate high student effort and participation.

'Posting by due date' data shows that, for the Module 1 activity, all students posted by the due date in 2016, while 33/38 (87%) did so in 2017. This contrast significantly with data for due date posting for Module 2 (Experimental design activity) with 17/28 (61%) postings on time in 2016 and 0/38 (0%) in 2017. This points to the fact that Module 2 activity is more stressful, requires more time and effort from participants as more critical thinking, active learning, and discussion is involved in this activity. Students needed more time to post the final version of their work.

Data based on reflection responses at the end of the course were generally positive. Points made by students as 'their biggest take-away' and 'most useful resource/activity during the entire course' included appreciation of the advantages of the discussion forum and the potential that this tool offers for active learning. Least useful resource/activity was generally seen as the Module 1 activity. Given the opportunity and logistics necessary, this should ideally take place in first term of the academic year (e.g. November). In the 'other comments' reflection responses, deadlines were a problem in the Module 2 activity. This is supported by data concerning postings by due date. This is understandable as this activity required more effort in terms of time management and critical thinking than a normal assessment activity. Some students had a difficult time with the technology, in particular internet access. Another student commented on the possibility of using the discussion forum for other topics and the advantage of incorporating online resources in discussion forums, as this meant that these can be shared by the online learning community and viewed a number of times at the student's own pace and time.

One final point is that a number of students did not cope with the work load on time. To quote from the literature, one of the challenges of technology enhanced courses that do not replace classroom activities with online activities is the 'course-and-a-half syndrome'. Course-and-a-half syndrome involves adding more and more online components to

a course without reducing any of the face-to-face instruction.[9] Effective blended learning considers the strengths of both the online and face-to-face environments and strategically incorporates activities that take advantage of the strengths in both environments. This involves rethinking the course design. To help avoid course-and-a-half syndrome, the blended learning initiative should eventually consider redesigns that replace some 25% of face-to-face time with online activities.

Conclusions and recommendations

The present course needs some tweaking to facilitate further effective students' participation and further collection of data. The general outcome of the course was positive. Students initially needed guidance in the use of the discussion forum and this was provided in a face-to-face environment. It was important for me as facilitator to overview the discussions and guide or give feedback where appropriate.

Recommendations for future work are to introduce a one-week activity (icebreaker activity early in November of the academic year). This would have the benefit of establishing an online learning community early on in the year. The Module 2 type of activity can take place later on during the second term (March), following the experimental design laboratory sessions that take place in a F2F activity in the biology programme.

Module 2 type of activity (involving critical thinking, active learning, and discussion) can include topics other than experimental design e.g. discussion of essay plans or review of data analysis questions.

Time management tips and length of time to be spent on the various activities during the course may be helpful to students and can be included in the course design.

Finally, this was a time consuming activity for both facilitator and students. It would be ideal if the various educational institutions were to promote effective online courses of high standard also by providing adequate time slots for facilitators and students of such courses.

9 W. Freeman & T. Trembl, 'Design Considerations for Supporting the Reluctant Adoption of Blended Learning', *Journal of Online Learning and Teaching*, March 2013, Vol. 9 (1), 80.

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